Moist Soil Management Plan

Hatchie National Wildlife Refuge

Introduction

Wildlife managers have long known that wildlife, particularly waterfowl, and especially dabbling ducks, often concentrate on shallowly flooded sites vegetated by wild herbacious plants. Natural circumstances where this situation occurs include single tree openings in seasonally flooded lowland forests; abandoned, silted-in beaver ponds, and temporary wetlands in prairie systems. Waterfowl managers attempt to simulate those conditions by establishing communities of moist soil plants through manipulation of water levels in spring and summer. Vegetation that germinates on exposed mudflats is then routinely flooded during fall and winter to make the wild seed crop and tubers available to waterfowl.

Numerous factors, besides time of drawdown, duration and speed of drawdowns, temperature, precipitation, seed availability influence the composition of resultant communities. Hence, a given site may produce highly different communities in different years, even if drawdown dates are held constant.

Basic principles of plant ecology hold that early successional stage annuals generally produce more seeds than perrenials of later successional stages. Hence, annuals potentially produce the most waterfowl food, and are favored by managers who must periodically set back succession to maintain high seed production.

In the last two decades, production of native waterfowl food plants, as opposed to rowcrops, has become an established wetland management option in many parts of the United States, particularly in the midwest. That option is, perhaps, less accepted in nontidal areas of the Southeast. In 1981, a decision was made to initiate in 1982, a moist soil management program at Hatchie National Wildlife Refuge. This document provides initial planning guidance for implementing that program.

Definitions

Several of the terms used in this plan have not achieved universal usage and meaning in the wildlife management field. As used herein they are defined as follows:

1. Moist Soil Management: The management and manipulation of seasonally flooded wetlands to produce a mudflat associated community of plants, providing food and/or cover for wildlife.

2. Moist Soil Plants: Those plants adapted to germinate in saturated soils. Best germination for most species occurs when soil moisture is at or slightly below field capacity. From the waterfowl food standpoint, these species are primarily members of the Graminae, Cyperaceae, Compositae, and Polygonacae.

3. Impoundment: Sites suitable for moist soil management at Hatchie are locally referred to as "dewatering areas". In other locales they are called "moist soil units", "rice fields", "marsh impoundments", "seasonally flooded impoundments", etc. All those terms refer to "man-made seasonally flooded impoundments", which is perhaps the most correct term. "Impoundments" is herein used as being the least cumbersome, most accurate term.

Attributes of Moist Soil Management

1. Moist soil plants are naturally adapted to sites where they occur. Such is often not the case with many agricultural crops. Moist soil seeds regularly survive long periods of flooding, and remain sound and viable, ready to germinate when conditions are appropriate. Residual seeds in detrius and soil bank can provide wildlife food for years after their production. Agricultural crops such as corn, rice and soybeans, in contrast, deteriorate rapidly after several months of inundation.

2. Publicly owned wetlands are often the lowest, wettest sites in a given area. Because of extensive spring flooding and poor drainage on such sites, conditions for conventional rowcrops are usually less than optimum. In many areas, rowcrops may produce "good" or average yields in as few as one year in three-five. Moist soil plants, on the other hand can be counted on to produce in almost any year. For example, if there is a late spring, and conditions are not favorable for an early drawdown to stimulate smartweeds, (Polygonum spp.) a mid-summer drawdown may produce excellent stands of other desirable foods such as redroot flatsedge (Cyperus erythrorhizos) or panic grass (Panicum spp.).

3. Wild plants cannot produce as much total food energy as good rowcrops, i.e. optimum yields of smartweed and barnyardgrass (Echinochloa spp.) contain less energy than optimum yields of corn. However, wild plants can produce higher returns on energy expended than rowcrops. For example if it takes 150Kcal (tractor fuel, fertilizer, herbicides, etc.) to produce a corn crop of 300 Kcal, the energy return is 2:1. Moist soil plants, on the same site, may produce 300 Kcal of energy with an input of 50 Kcal, a return of 6 : 1. Hence, moist soil management, on some sites, is more cost effective (in terms of dollars and energy) than rowcrops.

4. Moist soil plants routinely provide a more diverse habitat and food source than rowcrops. In one area where corn provided food and habitat for 15 bird species, moist soil management supported use by 81 species.

Enhanced diversity in invertebrate, herptile and mammalian fauna could also be expected with moist soil management. Even in terms of waterfowl, diversity can be increased. Rowcrop management traditionally supports large numbers of Canada geese, mallards and black ducks. Moist soil management can enhance habitat for increased usage by other dabbler species, with different food habits.

5. Although moist soil plants may provide less food energy per unit area than rowcrops, wild foods (invertebrates as well as seeds) produced by moist soil management provide a more nutritionally complete diet. For example, even those cereal grains with high gross protein content often lack essential amino acids, required by waterfowl, that are found in wild foods.

Nothing stated in the preceeding paragraphs is intended to imply that moist soil management is "better" than rowcropping, or that all impoundments should be managed for natural food production. Agricultural crops are a major component of any integrated impoundment management scheme, and where large concentrations of geese must be supported, they are considered essential. Moist soil management is simply one option for impoundment management that can provide important benefits for waterfowl and other wildlife. On some sites, under some circumstances, it is the best option and can provide more of those benefits than rowcrops. Neither moist soil nor corn provide all the answers.

Some Principles of Moist Soil Management

Moist soil management is based on the creation of mudflats, the seed bed of moist plants. The management decision is when and how to create mudflats. Drawdown dates and flooding schemes are best arrived at from past experiences on a site, and especially on the local phenology of wildlife species. Although moist soil plants species differ with locale and latitude, both in occurence and phenology characteristics of important genera are generally similar. For example, smartweeds usually respond best to very early drawdowns; barnyardgrass (wild millet) to slightly later drawdowns, and flatsedges (*Cyperus* spp.) and crabgrass (*Digitaria* spp.) respond well to late drawdowns in mid-summer. Similarly, cutgrass (*Leersia* spp.) usually responds on the wettest portions of impoundments; barnyardgrass and panicum to intermediate moisture conditions; and beggarticks (*Bidens* spp.) and foxtail (*Setaria* spp.) on the highest, dryest sites.

The composition of a moist soil plant community also depends on availability of viable seeds. Wide experience indicates that most impoundment soils contain sufficient quantities of desirable species seeds to produce good stands, even after years of cultivation.

When waterfowl are the target of moist soil management, it is important to maintain early successional stage species. In most instances, moist soil production is best the first year following rowcrops and declines thereafter. Most managers farm their impoundments every three-four years. Succession can

also be set back by discing and extended flooding. It is sometimes desirable to allow impoundments to advance successionally to enhance nonwaterfowl species such as rails and passerines. In the Eastern Forest biome, however, mechanical disturbance will be required at some point to halt invasion by woody species.

The primary undesirable herbaceous plant in the mid-south is cocklebur (Xanthium spp.). Cocklebur is adapted to germinate under conditions that also favor the majority of desirable moist soil plants, although cocklebur problems are more likely with later drawdowns. Fortunately cocklebur seedlings will not survive floodings. Seedlings one to about four inches tall can be killed with a one inch shot of water for one-two days. Desirable seedlings can survive such flooding. Woody vegetation and vines, such as willow (Sulix sp.) and trumpet creeper (Cumpsis mdicans) are also undesirable from the waterfowl standpoint. These species often invade an impoundment after several years of moist soil management. Soil disturbance at about three-year intervals is usually the best way to reduce or eliminate woody vegetation.

Most desirable moist soil plants can be partially flooded once they achieve eight to ten inches in height. Initial flooding should be two to four inches and should not exceed one-half plant height during the growing season. This "irrigation" flooding not only stimulates plant growth, but also provides habitat for wading birds, reptiles, amphibians and other wetland oriented wildlife in summer. Flooding depths can be increased sufficiently to provide teal and rail habitat in late August-September without harm to seed production.

Residual effects of herbicides applied in previous farming operations do manifest themselves in species composition in subsequent moist soil management. However, research, to date, has not addressed those effects and they remain a major "unknown" in moist soil management.

Fine differences, such as one-two inches of water or elevation, have profound impacts on moist soil plant species composition. In the first years after agriculture, totally different plants can often be observed growing in the residual hills and furrows. This characteristic is actually beneficial because diversity is increased. Furthermore, if precise water control is available, this permits the manager to manipulate impoundments with addition or removal of only one-two inches of water. Hatchie NWR impoundments have an undulating topography and can be expected to produce diverse mosaics rather than uniform stands of moist soil plants.

Moist soil management requires relatively little expenditure in terms of equipment and chemicals, but frequent managerial inspection is essential. Managers should check impoundments regularly during the growing season, especially during periods of mudflat exposure and germination. Only by being familiar with the changing situation on the impoundments, can the manager implement manipulations at the proper time to control or stimulate vegetation.

Rationale for the Hatchie Decision

The decision to implement a moist soil management program at Hatchie NWR was arrived at carefully and with much thought. Major factors influencing the decision included:

1. Most Hatchie Impoundments are on low poorly drained sites. The Hatchie River and its tributaries regularly inundate some impoundments well into the crop planting season. Late planting of corn, and other crops often result in a too short growing season and/or severe crop damage by pest insects. Experience has shown that several particularly low impoundments produce acceptable yields of rowcrops only once every three to five years.

2. The agriculture program on Hatchie impoundments in conducted solely on a Cooperative Farmer basis, where the refuge's share of the crop available to wildlife is 25 per cent. Force account farming is not conducted; it is very expensive and will become even less cost effective as Service fiscal resources continue to dwindle. Under past (1981) conditions, cooperators must harvest part of their 75 per cent share from impounded fields. Hence we have impoundments, with economical gravity flooding capabilities, producing very little food because the cooperative farmer has removed the annual production.

3. Hatchie may be missing an opportunity to support a substantial number of use-days by waterfowl and other wetland oriented migratory birds. During early fall migration, when species such as blue-winged teal and pintails are passing, we have had very little habitat available. Rowcrops cannot withstand flooding during their growing season, but moist soil vegetation can be flooded in August-October, providing habitat for early migrants without harming seed crops. Moist soil management can also provide habitat for significant numbers of rails, shorebirds and wading birds that crops do not. These species are highly desirable for non-consumptive use and are worthy of more consideration in refuge management.

Plans for 1982-83

Based on the preceeding factors, portions of 4 impoundments totaling 89 acres will be withdrawn from the Cooperative farming program and managed for moist soil plants in 1982 (see attached map). Included are 10 acres of the New Hillville Unit; 24 acres of the Friedman Unit; 10 acres of the McCool Unit, and 35 acres of the Windrow Unit.

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All areas were selected on the basis of past poor rowcrop production. With the exception of New Hillville, they are not the sites best suited for moist soil management; optimum moist soil management requires precise water control capabilities not available at the Friedman, McCool and Windrow Units. But, because of the aforementioned attributes, they are sites where moist soil management is the best option.

Approximately seven acres on the New Hillville site, although not actively manipulated, was allowed to grow up in natural vegetation in 1981. The area produced a good stand of valuable moist soil plants including barnyardgrass, curltop ladysthumb (Nodding smartweed) (Polygonum lapathifolium), Sprangletop (Leptochloa sp.), crabgrass, panicum, and beggarticks. Those results confirm a viable soil bank of seeds of desirable plants on the Hatchie impoundments. Because there is little moist soil experience at Hatchie, manipulations planned in this first year will be largely experimental and based on experience elsewhere. The primary objectives of the Hatchie program in 1982 will be to provide food for wintering and migrant waterfowl. However, some manipulations will also be conducted to enhance habitat for nonwaterfowl species, particularly rails, shorebirds and herons.

The following management prescriptions are planned for the Hatchie impoundments for the remainder of 1982 and 1983. Deviations may be required to control undesirable vegetation or take advantage of "targets of opportunity" such as heavy summer rains. Some of these plans may not prove feasible. During extremely wet springs, it may not be possible to conduct drawdowns at planned times if flood waters are high outside levees. Also, planned summer drawdowns may be redundant if impounded waters evaporate off.

During the spring of 1982, several manipulations were attempted as prescribed by a previous draft of this plan (presented at the Programmatic Evaluation on January 26-27, 1982). Several unforeseen problems with levees and drainage systems became apparent. In attempting to follow the manipulation plans as closely as possible, we will find out what will and will not work at Hatchie. Several years of experience will permit more accurate planning in the future.

A. New Hillville Unit (20 acres)

A gradual drawdown was conducted from the end of March through April 1982. Only about 50 per cent of the area was flooded prior to drawdown. Plant response was disappointing. The lower portion of the area, which has not been rowcropped for three years, was invaded by woody species, primarily trumpet creeper. The higher portion produced many desirable grasses, but with heavy infestation of cocklebur. Because the exterior levee of this impoundment was scheduled for rehabilitation under BLHP, no water could be applied for cocklebur control.

On July 2 and 7, the entire area was disced. The levee was reconstructed in July and modifications were made to facilitate better water control. Because of the recent earthwork, further manipulations in 1982 will not be possible.

In 1983, we will attempt the same general drawdown scheme, from late March through April. This timing will keep water in the area for use by blue-winged teal and other late migrant ducks, and mudflat exposure will coincide with spring shorebird migration. With improvements made in 1982, we will have the capability to apply water for cocklebur control, if needed.

Fall flooding will begin in early September, with initial depths of two to six inches to provide rail habitat. Water depths will be increased to twelve to fifteen inches in mid-October and maintained through the waterfowl wintering period.

B. Friedman Unit (24 acres)

This impoundment presents a peculiar problem because a substantial green timber area lies within the same levee system. Although occasional late drawdowns are possible, several years of flooding into June-July will damage the timber. Neither are consistent late drawdowns desirable, because if cocklebur infestation occurs, there are no capabilities to control it by reflooding.

During the second week of February 1982, high water "blew-out" the exterior levee of this area, and the field was dewatered rapidly by late February. A fairly good stand of vegetation resulted in the milo stubble. A dense growth of beggarticks germinated on the lower portions of the unit, and many grasses germinated on higher sites. Cocklebur infestation is minimal. If sufficient rains are received in August, a fair-good crop should result. Stop-logs will be replaced in mid-October to take advantage of autumn rains but reflooding will still be dependent on general flooding in the Poplar Creek drainage.

During July 1982, the levee was repaired. We plan to conduct a rapid drawdown around the first of May 1983, with similar reflooding scheme in fall 1983.

C. McCool Unit (10 acres)

This impoundment has historically supported very little waterfowl use, and traditionally produces poor crops. It is a small area, with major highways adjacent on east and west sides. Water control is presently minimal due to deficiencies in the levee system. We learned in the spring of 1982 that it is presently impossible to hold water in this field once general flooding has dropped in the "bottom". Permits to add to the existing levee system were requested in June 1982. If these modifications are made, more precise control will be possible in 1983.

The area was completely dewatered by March 20, 1982. A rather poor stand of mixed grasses, sedges and forbs germinated. In 1983, this impoundment will be managed for wading birds. Stop-logs will be left in place to hold water through summer. It is hoped this scheme will stimulate establishment of more aquatic vegetation such as bulrushes (Seirpus spp.), beakrush (Rhynchonpora sp.) and pond weeds (Potamogeton spp.). This will create a botanically unique and interesting area on the refuge. Invertebrate and herptile populations should be enhanced, attracting herons to an area highly visible to the public. Waterfowl benefits anticipated include increased use by migrant blue-winged teal and shovelers and breeding wood ducks.

D. Windrow Unit (35 acres)

This is the only moist soil area where rowcrops were also planted in 1982. Elevations within the levees vary greatly. Several deep, wooded sloughs course through the area. A cooperative farmer planted 20 acres of high ground to milo; the remaining non-wooded areas were managed for moist soil plants.

A three-phase drawdown was conducted on April 15, May 5 and May 12, 1982. An outstanding stand of vegetation, dominated by barnyard grass was established throughout the impoundment.

In 1983, a similar drawdown scheme will be employed. Water levels will be dropped in early April, mid-May and mid-June. A traditional winter flooding scheme will be followed, with stop-log emplacement in mid-November.

Management Study

Results of the first two years of the Hatchie Moist Soil experiment will be documented by data collected in a formal management study. The proposal for that study is appended to this plan. Data on plant response to manipulations, seed production, avian use, and mallard feeding ecology will be collected and compared to areas in rowcrop management. Results will be reported to higher Service echelons in progress and final reports. Evaluation of study results will assist in future decisions regarding the moist soil management option.

Acknowledgement

Although much of this plan is based on personal experience, and citations to technical publications were not used in the text, I have drawn freely on the work of others in its preparation. The bulk of the information was drawn from Fredrickson and Taylor (Management of Seasonally Flooded Impoundments for Wildlife. U.S. Fish and Wildl. Serv. Resour. Publ. 63 pp. in press), and many of the over 115 papers listed therein.

Prepared and Submitted by Dean Rundle (my J.C.B.) Date 7/28/82

Approved by J. C. Bryan Jr. Date 7/28/82

Area Office Concurrence Carroll L. Lyon Date 7/30/82

MANAGEMENT STUDY PROPOSAL

Hatchie National Wildlife Refuge

Brownsville, Tennessee 38012

1. Title: Production and avian use of moist soil vegetation at Hatchie National Wildlife Refuge

2. Project Number: 42525-1

3. Objectives:

   A. Examine moist soil plant response to manipulations of refuge dewatering areas.

   B. Determine seed and gross energy production of moist soil vegetation, and compare to row crops.

   C. Examine avian use of impoundment managed for moist soil vegetation, and compare to row crops.

   D. Investigate food habits of wintering mallards on refuge dewatering areas.

4. Justification:

Hatchie National Wildlife Refuge (NWR) has 5 seasonally flooded impoundment complexes, locally referred to as "dewatering areas". There are 14 subimpoundments, with varying degrees of water control capabilities, that total about 330 acres. The impoundments play an important role in pursuit of refuge waterfowl objectives. Historically, the impoundments have been planted with row crops by cooperative farmers, and flooded from mid-November to early March. Several subimpoundments have a history of poor crop production. Because of poor drainage characteriestics, they are seldom dry enough to cultivate in early summer, and produce satisfactory corn crops in as few as one year in five (Annual Narrative Reports, HQ, Hatchie NWR). The Cooperative:Refuge share ratio of 3:1 necessitated cooperator harvest from impounded fields, Hence, those fields produce little waterfowl food.

Managers have long recognized that waterfowl, especially dabbling ducks, concentrate on sites where flooded stands of native vegetation have germinated on mud flats (Low and Bellrose 1944, Addy and MacNamara 1948, Uhler 1955, Givens and Atkenson 1957, Green et al 1964, Burgess 1969). Native plants are adapted to wet soil conditions. Their seeds remain viable during long periods of inundation, when agricultural crops deteriorate, (Neely 1956, Shearer et al, 1969) and germinate when soil moisture conditions are suitable.

Many annual grasses, sedges, smartweeds and composites produce excellent waterfowl foods. These desirables occur early in wetland plant succession; soil disturbance or water manipulations are required to maintain high seed production (Fredrickson and Taylor in press). Several authors (Burgess 1969, Ermacoff 1969, Linde 1969, Meeks 1969, Wills 1970, Knauer 1977, Taylor 1977, Prevost et al. 1978) have described management techniques for moist soil plants and seed production. Production of moist soil seeds regularly exceeds 1000 lbs./ac., but native plants cannot produce as much total food as good crops of corn and other grains.

Seeds of moist soil plants are highly nutritious (Bardwell et al. 1962, Kendeigh and West 1965, Knauer 1977), and may provide essential nutrients lacking in cereal grains. Bellrose and Low (1978) noted that while geese respond very well to cultivated grains, most ducks require a diversity of foods for adequate nutrition. Diets of many natural foods may also reduce mortality from lead poisoning that is severe on corn diets (Jordan and Bellrose 1951, Jordan 1968).

Spectacular concentrations of Canada geese (Branta canadensis), mallards (Anas platyrhynchos) and pintails (Anas acuta) often respond to agricultural crops. But, avian species richness in agricultural fields is generally low (Taylor 1977). In contrast, temporally flooded wetlands with a diverse native flora provide food and habitat for an array of avian species (Burgess 1969, Taylor 1977, Rundle and Fredrickson 1981).

Based on the above, it was decided to initiate a moist soil management program at Hatchie NWR in 1982. (See attached Moist Soil Management Plan). The moist soil management option was discussed during a programmatic evaluation on January 26-27, 1982. The Evaluation Report from the Assistant Regional Director recommended an evaluation of the moist soil management program and called for reporting the results of this evaluation.

This Research/Management Study is designed to satisfy those recommendations. Results will facilitate future management decisions regarding the continuation, expansion or cessation of the moist soil option at Hatchie NWR. Results may also assist managers of other Refuge System Units who may contemplate managing their impoundments for natural vegetation.

5. Procedure:

A. Materials and Methods

1. General

Data will be obtained at all impoundments involved in the Moist Soil Management Program (see attached map). However, only plant response and seed production data will be collected on the McCool Area, because of its close proximity to highways.

Plant response, seed production, avian use and mallard food habits data sets will be obtained at the New Hillville, Friedman and Windrow areas.

The New Hillville, Friedman and Windrow areas will each be paired with adjacent rowcrop fields. Avian use, food production and mallard food habits data will be collected in those selected crop fields for comparison purposes. Because they do not require assumptions of normalcy, and can be easily computed on calculators on-hand at the refuge, nonparametric statistical tests will be applied to the data. As a minimum, Mann-Whiteny U Tests (Seigel 1956) will be applied to test the hypothesis of equivalence between row crop and moist soil field pairs for the food production, avian use and mallard food habits data. The 0.05 significance level will apply to all tests.

2. Moist Soil Plant Response/Seed and Energy Production

A permanent random line transect will be established on each study impoundment. The transect line will be marked with wooden stakes and flagging. Markers will be removed at the end of the study.

Plant response to moist soil management will be determined by frequency of occurrence of plant species. A point intercept method (Knauer 1977) will be used. Individual plants that touch foot markers, or bisect the vertical plane of those markers, of steel tape, laid on the transect line will be recorded. Frequency of occurrence for each species is obtained by dividing the number of observations per species by the total number of observations.

Seed production will be determined by the use of seed catch pans (Taylor 1977). Six 5 x 50 cm seed catch pans, will be randomly located along each 100 m of transect line in July of each year. A wire mesh will be fastened to catch pan tops to reduce seed loss to rodents. Catch pans will be collected each November. Seeds will be removed, air dried, sorted to species, and weighed to the nearest mg. Data from catch pans will be extrapolated to yield production in kg/ha.

During the period of catch pan collection, random crop samples will be collected in the paired crop fields. Using the linear feet; acre ratio, row crop production in kg/ha will be determined for comparison to moist soil seed production. Using the production figures determined from catch pans and row crop samples, gross energy production of seeds for row crop and moist soil field pairs will be calculated from previously published values (Bardwell et al 1962, Kendeigh and West 1965, Knauer 1977, Robel et al. 1979).

3. Avian Use

Avian use will be determined by censusing of moist soil and paired crop fields. Censuses will be conducted at least twice monthly, from September 1982, until June 1984. Censuses will be systematic, beginning with a sweep of impoundments with binoculars or spotting scope to count waterfowl, raptors and large wading birds. Walk-throughs will then be conducted at 100m intervals to detect rails and passerine. Numbers of each species observed will be recorded. Use-days for each species will be calculated by multiplying the mean number of individuals observed on two consecutive censuses by the number of days between those counts (Rundle and Fredrickson 1981). Avian species richness and waterfowl use-days/ha will be compared between field pairs.

4. Mallard Food Habits

Wintering mallards will be collected following procedures described by Swanson and Bartonek (1970). Birds will be collected after a minimum observed feeding period of ten minutes. Contents of the esophagus and proventriculus will be removed immediately in the field and preserved in 95% ethanol. Laboratory analysis will follow Drobeny and Fredrickson (1979). Esophageal contents will be soaked overnight in distilled water to restore volume of invertebrates, dried on a towel, and sorted under a dissecting microscope. Foods will be measured by liquid displacement to the nearest 0.01 ml. Data will be tabulated using percent occurrence and aggregate percent methods (Martin et al. 1946, Swanson et al. 1974). to reduce biases caused by variations in individual sample volume.

Collections will be made under the Scientific Collecting Permit issued to the Area Manager. Collections will be made in Dec.-Jan. 1982-83 and 1983-84. A sample of 15 mallards of each sex from both row crop and moist soil areas, a total of 60 birds, will be collected. This sample is large enough to yield meaningful results, but will have no significant impact on refuge waterfowl populations.

B. Results

Results of this study will be presented in a series of reports (see 10 below). Data will be presented in the form of appropriate tables, figures and narrative. Reports will be written in technical style.

C. Interpretation

Interpretation of study results will facilitate management of refuge dewatering areas. Avian, and especially waterfowl use information will help determine the future of the moist soil program. Plant response data, combined with data on production and mallard food habits will greatly assist in planning future manipulations to

produce the most desirable stands of vegetation. Comparisons with data from row crop fields will help determine future expansion or reduction of the row crop and moist soil options on refuge impoundments.

6. Cooperators

A. We anticipate receiving some assistance in plant identification from Dr. Ted Brown, Biology Department, Memphis State University, Memphis, TN.

B. Gaylord Memorial Laboratory, University of Missouri-Columbia, Puxico, MO has agreed to loan us seed catch pans that were used in a previous, FWS funded moist soil study at Mingo NWR. Also, carcasses of mallards collected for food habits analyses will be provided to Gaylord Laboratory for use in a Mallard Wintering Ecology study being funded by the Office of Migratory Bird Management (Contract 4 USDI 14-16-0009-801-092). That is Refuge Management Study #33540-1 of Mingo NWR.

7. Responsibility

The study will be conducted, in whole, by the staff of Hatchie NWR. Refuge Manager J. C. Bryant has overall responsibility for all refuge operations. Asst. Mgr. Dean Rundle has primary responsibility for the planning and execution of all phases of this study. Other members of the refuge staff may be called upon to assist in specific field work.

8. Cost

Cost of all field work, analyses of data, supplies and equipment will be borrow by O & M funding of Hatchie NWR. Projected costs include only those directly attributed to the study and do not include costs for routine, planned management activities.

	FY 1982	FY 1983	FY 1984	FY 1985
Salary (Refuge Staff)	$750	$3000	$2250	$225
man/days	10	40	30	3
Operation Vehicles	$50	$300	$200	-
Equipment (microscope)	$974	-	-	-
Materials-Supplies	$100	$50	$50	-
Travel & Per Diem to Professional Meetings	-	-	-	$500
Total	$1874	$3350	$2500	$725

Grand Total: $8449.00

9. Schedule

FY	Dates	Activity
82	July 82	Prepare study plan, establish transect lines, place seed catch pans.
82	Sept. 82	Collect plant occurrence data, begin bi-weekly bird censuses.
83	Nov. 82	Collect seed catch-pans, begin analyses of 1982 seed production.
83	Dec. 82-Jan. 83	Collect mallards for food habits analysis.
83	Feb.-May 83	Analyze, summarize data collected on first 2 quarters of study.
83	May 83	Submitted Progress Report.
83	July 83	Place seed catch pans, collect plant occurrence data.
83	Sept. 83	Collect plant occurrence data, end plant occurrence data collection.
84	Nov. 83	Collect seed catch-pans, end seed production data collection.
84	Dec. 83-Jan. 84	Collect mallards for food habits data, end mallard food habits data collection.
84	Feb.-May 84	Analyze, summarize data for second field season.
84	May 84	Submit progress report.
84	June 84	End bi-weekly censuses.
84	June 84-Sept. 84	Prepare final reports, presentations, manuscripts.
84	Sept. 84	Submit final study report.
84	Oct. 84-Mar. 85	Present findings at appropriate professional meeting.

10. Reports

Progress reports for the two winter field seasons will be submitted to offices designated in 4 RM 6 in May 1983 and 1984 respectively. A final study report will be submitted NLT Sept. 30, 1984.

11. Publications

It is intended that results of this study will be presented in the form of a scientific paper at an appropriate professional meeting such as the Annual Conference of the Southeastern Association of Fish and Wildlife Agencies. It is anticipated that the study will result on at least one manuscript publishable, in a referred journal or proceedings. Regional Office, or other Service Offices will be asked to off-set any publication costs.

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